# Visual and auditory signal detection[1]

CARL CHENEY AND PRESCOTT EATON
*EASTERN WASHINGTON STATE COLLEGE*

*Humans participated in a signal detection experiment wherein nontransient signals were set up according to three different schedules. For two visual Ss observing responses illuminated a meter for 0.40 sec. Two auditory Ss interrupted silence for 0.40 sec by pressing the observing button. Cumulative observing response curves from these four Ss showed (1) a high degree of control by the schedule of signals and (2) no substantial differences between Ss. This finding is taken to indicate that observing response patterns are not subject to any scanning artifacts unique to visual signal detection experiments.*

Human vigilance in signal detection experiments has been explained in terms of the schedule of signal presentation (Holland, 1958). The presence and detection of signals reinforced the observing responses. Various investigators have supported and extended these findings (Laties & Weiss, 1960; Jerison & Pickett, 1964; Johnston, Howel, & Goldstein, 1966). Nearly all of this research has been done using the visual sense modality.

Frankman & Adams (1962) criticized Holland's (1958) interpretation on the grounds that button-pressing as an observing response in a visual signal detection experiment may not have direct correspondence with sense receptor orientation and may in fact not yield identical behavioral laws.

It was the primary purpose of the present experiment to compare curves obtained from visual observing-response/signal-detection Ss with those derived from Ss observing/detecting auditory signals. The ubiquity of auditory signals minimizes the argument that button-pressing observing responses may not correspond with head and eye orientation as is possible when visual displays are used. One can consider that the ears are orientated to the signal source at all times when the signals are presented via an earphone headset.

## Method

Four male college students, ages 18-24, non-psychology majors participated in 19 consecutive, 40 min daily sessions. Two Ss detected visual signals and two detected auditory signals.

Standard laboratory programming equipment was used. The Ss were provided a lap board with a large button centered and nearest to S; this was the observing button and required 700 g pressure to operate. A smaller second button, off-center farthest from S was the detection button and required 200 g pressure to operate. Cumulative records were taken of the observing responses; detection button-presses were displayed as momentary pen displacements. Digital counts were taken of signal setups and all button-presses. Masking white noise was present in the S's room.

A 1000 cps tone presented well above threshold (50-60 dB) was used as the audio signal. The generator was ON continuously, but the signal was available in the headset circuit only when set up by the program and an appropriate observing response occurred. When such a signal was observed a detection button-press removed the tone from the earphone circuit.

Visual signals were in the form of off-center pointer deflections on a 2 in. meter. The meter was located 18 in. to the rear of a box and could only be viewed if the box interior was illuminated by an observing button-press. Detection button-presses reset the pointer to the center position. Observing button-presses brightly illuminated the box for 0.40 sec for the visual Ss and interrupted silence for 0.40 sec for the auditory Ss.

The initial session included playing tape recorded instructions which stated that signals could occasionally be observed by pressing the larger button. If such a signal (off-center pointer or tone) was observed the smaller button was to be pressed. A 15 min practice session was allowed. All subsequent sessions were 40 min long. During sessions two-six signals were set up on fixed interval (FI) 1.5 min schedule, sessions 7-11 were FI 3 min, and sessions 12-19 presented signals on a differential reinforcement of low-rate (DRL 20 sec) schedule. Schedule changes were abrupt from one series to the next with no additional instructions after session 1. The FI 1.5 min schedule programmed the presentation of a signal every 1.5 min. The signal was present for every observing response after this time and until a detection response was recorded. The FI 3 min schedule was the same except that signals were programmed every 3 min. The DRL schedule specified that a signal would be present for each observing response occurring at least 20 sec after the previous observing response. If observing responses occurred with an interresponse time less that 20 sec no signals would be presented.

## Results and Discussion

The total responses per minute of each S in Session 6, the last session on FI 1.5, were: S1 = 10, S2 = 258, S3 = 107, and S4 = 10. By the 11th session, the last FI 3 min, total rates differ between Ss by only six responses (S1 = 4, S2 = 10, S3 = 6, S4 = 8). Mean responses per minute during the 11th session are exactly the same for the two visual (Ss 1 and 2) and the two auditory (Ss 3 and 4) Ss. Rates at this

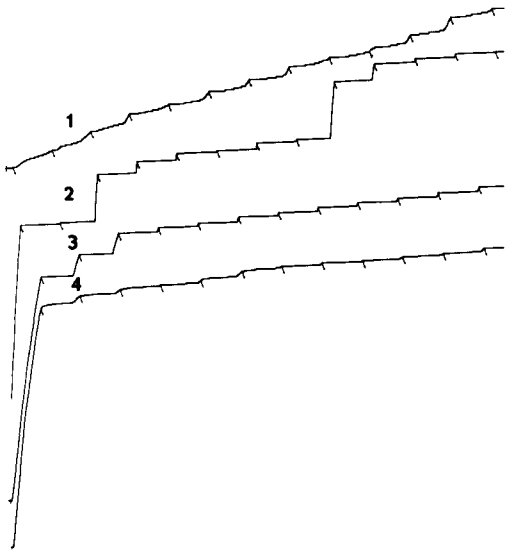


Fig. 1. Cumulative response curves for all four Ss during the fifth FI 3 min session.

time were stable for each S and had been for the past three or four sessions.

Gross inspection of the records in Fig. 1 reveals no substantial differences that might differentiate Ss on the basis of the sense modalities involved. Of interest is the regularity of responding and the typical scalloping.

As can be seen in Fig. 2 all responding in DRL is at a low and steady rate. Nearly every observing response is reinforced by the presence of a signal and a subsequent detection. Again no distinction can be seen between auditory and visual records.

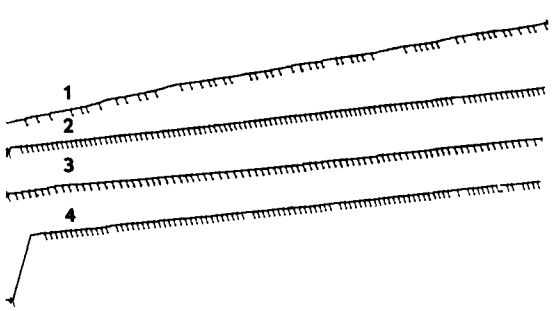


Fig. 2. Cumulative response curves for all four Ss during the final DRL 20 sec session.

The results of this study indicate that Ss making button-press observing responses display very similar behavior irrespective of the primary sensory system involved. The observing response curves obtained in this study cannot be differentiated on the basis of whether visual or auditory signals were involved. In all cases the observing response probability became a function of the schedule of signal presentation. When signals were set up on a fixed interval basis, observing responses tended to occur more frequently as the end of the interval neared and less frequently immediately following a detection. As a result of a few sessions exposure to the DRL schedule responding became regular and with few IRTs below 20 sec. Changes in the frequency of the observing/detection response have been attributed to such things as vigilance (Mackworth, 1948), attention (Broadbent, 1953), expectancy (Deese, 1955), and reinforcement (Holland, 1958). The results of the present study support the interpretation of Holland (1958). It seems clear that the manipulation of the schedule of signals resulted in predictable and stable changes in the observing response rate. In addition the sense modality involved does not appear a critical variable since no differences were obvious between visual and auditory Ss in terms of the measure taken. It might therefore be concluded that the Frankman and Adams criticism of Holland is not supported.

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**Note**

1. This research was supported in part by a grant from Eastern Washington State College.